

SINTEZA I BOJADISARSKA SVOJSTVA NOVIH BENZOTIAZOLSKIH AZO NAFTOLSULFONSKIH BOJILA

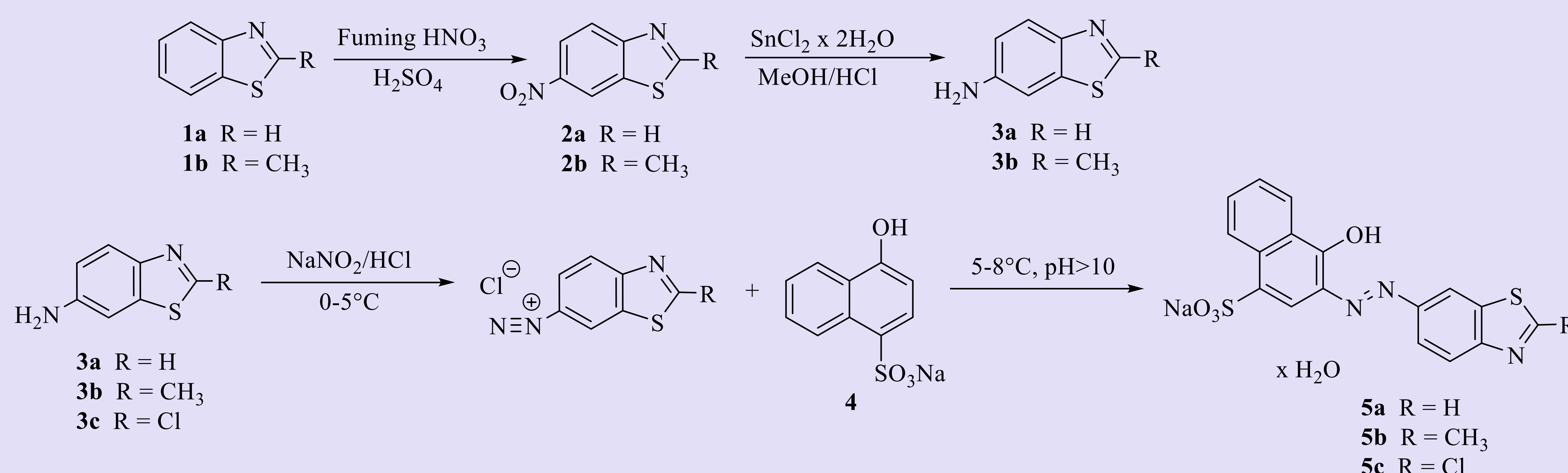
SYNTHESIS AND DYEING PROPERTIES OF NOVEL BENZOTHIAZOLE-BASED AZO NAPHTHOLSULFONIC DYES

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Aromatic and heteroaromatic azo compounds represent the largest and most diverse group of synthetic colorants with application not only in the textile industry but also in many other technological fields. Azo dyes prepared from heterocyclic diazo components show good colorimetric parameters, such as are hue and brightness. Among azo dyes, anionic dyes represent an important class of water soluble colorants widely used for dyeing protein and polyamide fibers due to their good affinity, bright shades, and ease of application [1]. Within this work, as a continuation of our research on azo dyes [2], novel benzothiazole azo derivatives of naphtholsulfonic acids were synthesized.



Scheme 1. Synthesis of novel azo dyes **5a–5c**

6-Aminobenzothiazole derivatives **3a–3b** were prepared by a multistep synthesis starting from the corresponding benzothiazoles. Compounds **3a–3b** and commercially available 6-amino-2-chlorobenzothiazole **3c** were diazotized and subsequently coupled with commercially available sodium 4-hydroxynaphthalene-1-sulfonate **4**, affording the novel azo dyes **5a–5c**. Dyes **5a–5c** were structurally characterized using UV/Vis, ¹H and ¹³C NMR spectroscopy, and elemental analysis.

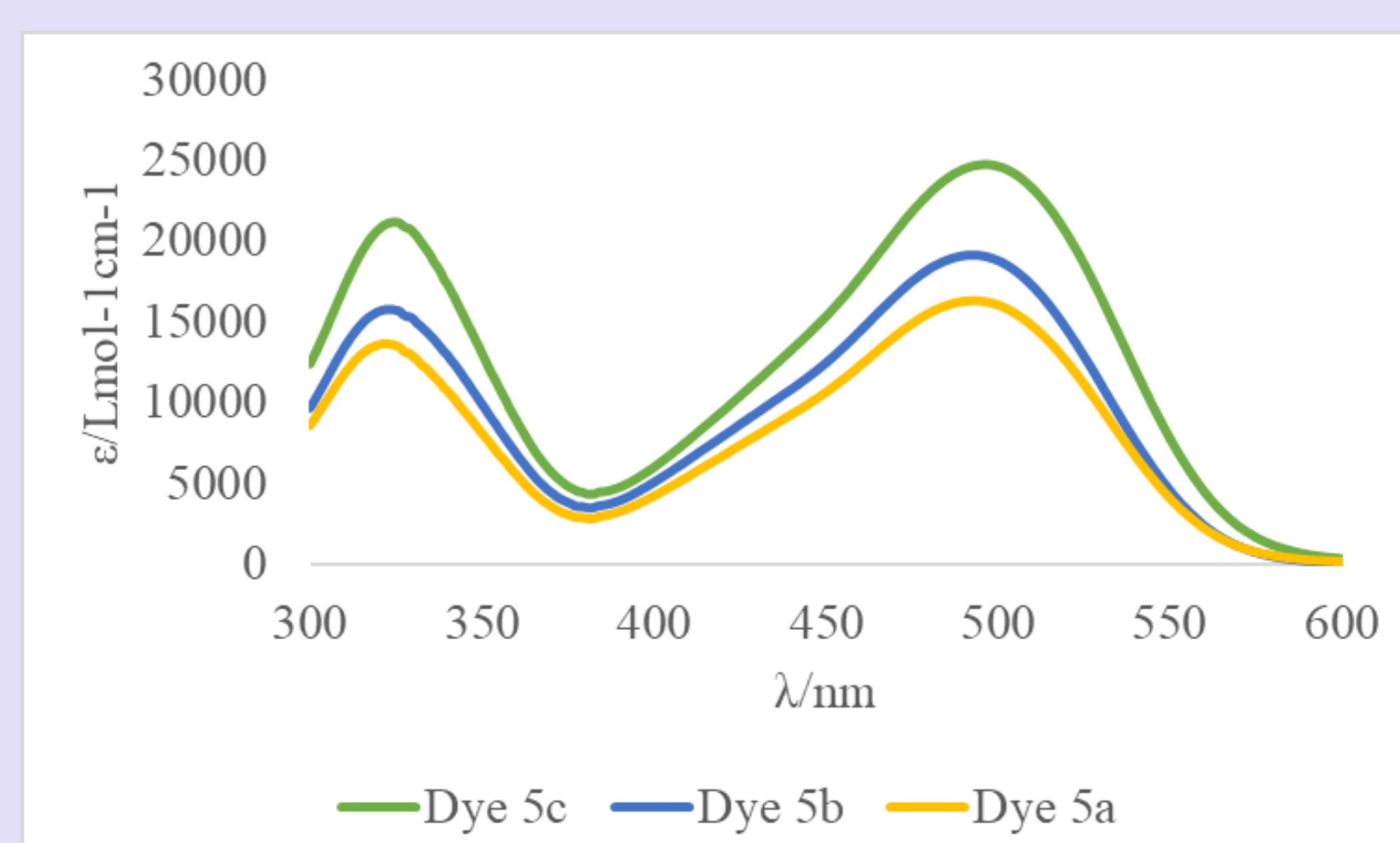


Fig. 1. UV/Vis absorption spectra of azo dyes **5a–5c**

The UV/Vis spectra of dyes **5a–5c** in aqueous solution showed similar absorption profiles, with an intense absorption band in the visible region at approximately 500 nm. Substitution at the C-2 position of the benzothiazole moiety predominantly affected the absorption intensity, with the highest molar extinction coefficient observed for the chloro-substituted dye **5c**.

Table 1. CIELAB colorimetric parameters and total color difference (ΔE) values for PA fabrics dyed with **5a–5c**, measured before and after washing. The data quantify wash fastness and color stability across dye–fiber systems.

Dye	State	L*	a*	b*	C*	h°	ΔE
5a	pre-wash	50.40	64.10	49.69	81.10	37.78	
	post-wash	48.84	62.80	47.33	78.64	37.01	3.11
5b	pre-wash	51.11	66.30	48.86	82.36	36.39	
	post-wash	51.33	65.33	46.79	80.36	35.61	2.30
5c	pre-wash	47.59	62.71	45.74	77.62	36.11	
	post-wash	49.19	61.45	42.08	74.48	34.40	4.19

The dyeing properties of dyes **5a–5c** were evaluated on polyamide fabric at 0.5% owf. Colorimetric analysis revealed moderate changes upon washing, with total color differences (ΔE) ranging from 2.30 to 4.19. Dye **5b** showed the smallest color change ($\Delta E = 2.30$) and only minor variations in the individual color coordinates, indicating the most stable colorimetric profile. Dye **5a** showed an intermediate change ($\Delta E = 3.11$), while dye **5c** exhibited the largest overall color difference ($\Delta E = 4.19$), accompanied by decreased chroma and a slight shift in hue after washing.

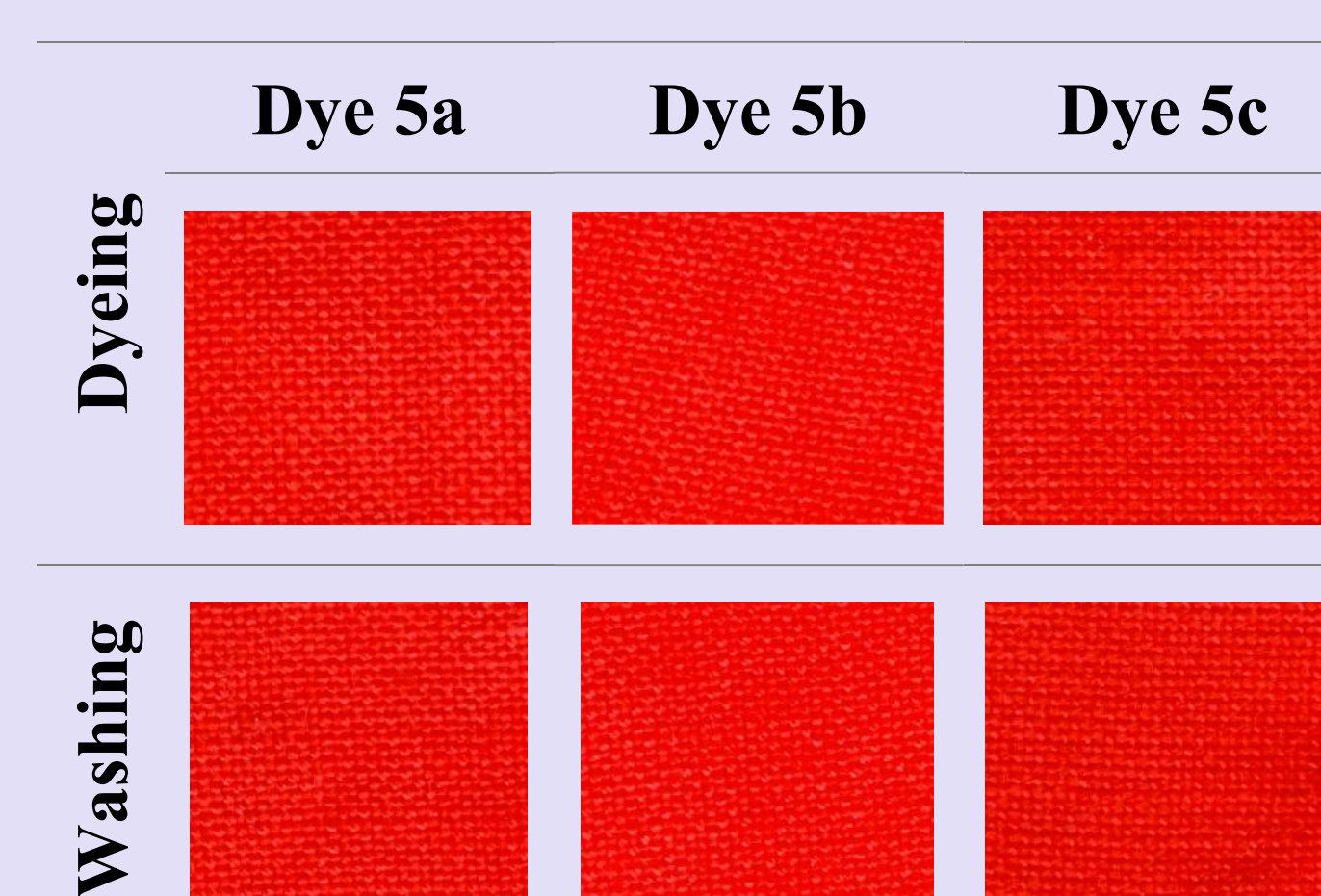


Fig. 2. Visual comparison of PA fabrics dyed with azo dyes **5a–5c**, before and after standardized washing.